

## WHAT IS CLAIMED IS:

1. A method of generating a scrambled signal having real symbols  $I_{s,k}$  and imaginary signals  $Q_{s,k}$  from a signal having real symbols  $I_k$  and imaginary symbols  $Q_k$ , comprising the steps of:
  - 5 generating a real part of a  $k^{\text{th}}$  element of a complex scrambling sequence  $(d_{I,k})$ ;
  - generating an imaginary part of the  $k^{\text{th}}$  element of the complex scrambling sequence  $(d_{Q,k})$ ;
  - generating a scrambling phase multiplier  $n_k$  according to:
$$10 \quad n_k = 2d_{I,k} + d_{Q,k}; \text{ and}$$
generating the scrambled signal:
$$I_{s,k} + jQ_{s,k} = (I_k + jQ_k)e^{j\left(\frac{2\pi n_k}{4}\right)}.$$
2. A method of scrambling symbols in a data transmission system,
  - 15 comprising:
    - scrambling all elements of a frame prior to transmission of the frame by the system so that all of the elements have a common reference phase.
  3. The method of claim 2, wherein the elements of the frame comprise a
    - 20 frame header or frame body.
  4. The method of claim 2, wherein the elements of the frame further comprise one or more pilot symbols.

5. The method of claim 2, wherein the scrambling step comprises performing a complex scrambling operation according to:

$$I_{S,k} + jQ_{S,k} = (I_k + jQ_k) \cdot \exp \left\{ j \frac{2\pi n_k}{4} \right\}$$

wherein:

5  $I_k, Q_k$  represents original symbols,  
 $I_{S,k}, Q_{S,k}$  represents scrambled symbols,  
 $n_k$  represents a scrambling phase multiplier, such that  $n_k = 2d_{I,k} + d_{Q,k}$ , and  
 $d_{I,k}$  and  $d_{Q,k}$  are real (I) and imaginary (Q) components of a  $k^{\text{th}}$  element of the complex scrambling sequence.

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6. The method of claim 5, wherein the complex scrambling operation comprises simple component swapping and sign changing according to:

$d_{I,k}$	$d_{Q,k}$	$n_k$	Rotation	$I_{S,k} + jQ_{S,k}$
0	0	0	0°	$I_k + jQ_k$
0	1	1	90°	$-Q_k + jI_k$
1	0	2	180°	$-I_k - jQ_k$
1	1	3	270°	$Q_k - jI_k$

15 7. An apparatus for scrambling symbols in a data transmission system, comprising:

means for scrambling all elements of a frame prior to transmission of the frame by the system so that all of the elements have a common reference phase.

20 8. The apparatus of claim 7, wherein the elements of the frame comprise a frame header or frame body.

9. The apparatus of claim 7, wherein the elements of the frame further comprise one or more pilot symbols.

5 10. The apparatus of claim 7, wherein the means for scrambling comprises means for performing a complex scrambling operation according to:

$$I_{S,k} + jQ_{S,k} = (I_k + jQ_k) \cdot \exp \left\{ j \frac{2\pi n_k}{4} \right\}$$

wherein:

$I_k, Q_k$  represents original symbols,

10  $I_{S,k}, Q_{S,k}$  represents scrambled symbols,

$n_k$  represents a scrambling phase multiplier, such that  $n_k = 2d_{I,k} + d_{Q,k}$ , and  $d_{I,k}$  and  $d_{Q,k}$  are real (I) and imaginary (Q) components of a  $k^{th}$  element of the complex scrambling sequence.

15 11. The apparatus of claim 10, wherein the complex scrambling operation comprises simple additions and subtractions according to:

$d_{I,k}$	$d_{Q,k}$	$n_k$	Rotation	$I_{S,k} + jQ_{S,k}$
0	0	0	0°	$I_k + jQ_k$
0	1	1	90°	$-Q_k + jI_k$
1	0	2	180°	$-I_k - jQ_k$
1	1	3	270°	$Q_k - jI_k$